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ABSTRACT

This paper reports on an experiment designed to collect data on children's perception and use of semantic attributes. Forty-five children ranging in age from 2 years 8 months to 6 years were given a picture test involving judgment of similarities between objects. The test consisted of 47 groups of pictures; each group contained a stimulus or a card and a set of two to three additional pictures on a page, all sharing an equal number of attributes with the stimulus. The subjects were divided into two groups. The first group looked at a stimulus and then pointed to the picture most like it. The second group was given nonsense names for each stimulus, such as "bork," and was then asked to identify another "bork." The features explored were: shape, size, color, texture/material, sound, function, situation, detail shape, pattern, age, sex, mass, real, animate, human, and species. It has been proposed that the earliest features a child attends to are perceptual. The results of the present study, described in detail here, seem to suggest that no preferential hierarchy exists among various perceptual categories. Whether shape, size, or color, etc. will be the most salient feature may depend on a particular context, namely what the respective values of the competing features are. (Author/PMP)

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SEMANTIC FEATURES IN LEXICAL ACQUISITION

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INTRODUCTION

In the investigation of children's acquisition of word-meanings, the notion of semantic primitive, or "feature," has been an important and useful one. A semantic feature hypothesis, such as that discussed by Eve Clark, provides a neat, theoretically simple way of explaining children's lexicon construction and overextension of words. It has been proposed that words in the earliest stage of lexicon building enter incompletely specified. Some entries might contain only one or two very general features, and thus cover a wider semantic domain than the corresponding adult entry. Semantic development consists of "filling in" missing features for each word, as new words are entered forcing finer differentiation of terms.

Such a model, which has many clear advantages, raises issues which at this point might be usefully explored. What, for example, determines which features are used in overextension? Is there a hierarchy of perceptual features? At some point we must decide what constitutes a feature in the first place. If we must add one for each new word we come across, if we can't limit in advance the size of the set of semantic primitives, then it's not clear what the theory buys us. Empirically, a large part of the lexicon has been examined only through diary studies, which all share the problem that even when much of the situation is recorded, the reason for the overextension of a word might be open to interpretation and speculation. These issues will remain unanswered until the type of controlled research used in examining, for example, relational terms is applied to the rest of the lexicon. There are many pockets of words which lend themselves easily to binary feature analysis. But dogs, cats, horses and cows are another question.

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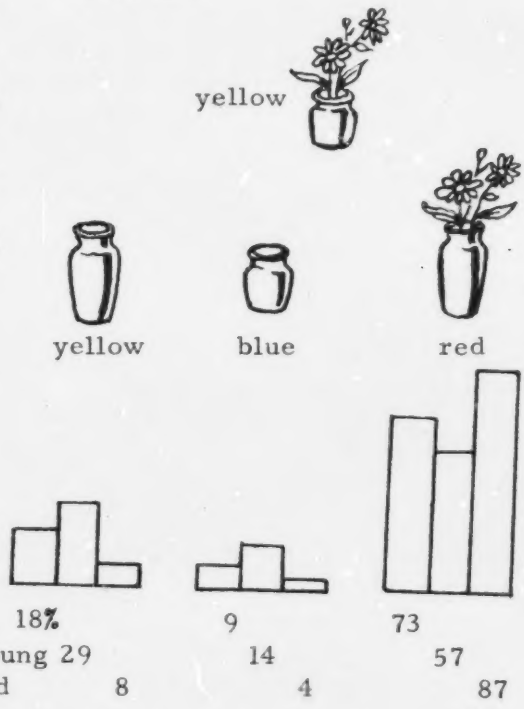
DESIGN OF EXPERIMENT

This paper reports results of an experiment designed to collect data on children's perception and use of semantic attributes, in the hope of dealing with some of these questions. Forty-five children (from L.A. area nursery schools) ranging in age from two years eight months to six years were given a picture test involving judgment of similarities between objects. The test consisted of forty groups of pictures, each group contained a stimulus on a card and a set of two to three additional pictures

on a page, all sharing an equal number of attributes with the stimulus (see figure 1).

A set of three pictures ideally should differ in the composite specifications of three features, in this case -- color, height and "contents." The pictures could be drawn such that each shares a different two out of three, or as in this example, each differs in two out of three.

Figure 1



Each child was tested individually and was given one of two tasks. The first group were asked to look at the stimulus and then from the set to "show" or "point to another one" or "the one most like it" (both wordings were used to optimize the chances of the child's comprehending the task).

The second group were given nonsense names for each stimulus, such as bork for the stimulus above, and asked to point to "another bork" (alternate wording used was "show me one here that might be a bork too"). The purpose was to see if features which were "utilized" in the similarity task differed significantly from a more linguistic task.

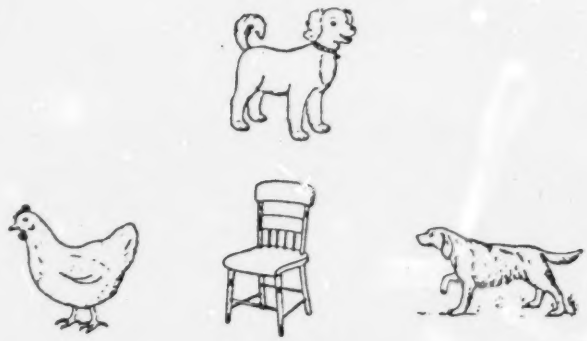
The average age of the children as a whole was 4 years 5 months. The average of each task group was within a month of the overall mean. Of the 45 children, 23 were given the linguistic task, and 22 the similarity task. Overall there were 24 girls and 21 boys.

THE SETS

Of the forty groups of pictures, the last eleven were repetitions, six exact and five approximate, with the choices reordered. The first set presented to each child was purposedly skewed to test the child's understanding of the task (see figure 2). Whatever features the chicken and chair share with the stimulus (animate and four-legged, respectively) the choice on the right shares both. Using this set as a criterion, all the responses of any child who did not pick the dog in this set, were

thrown out. Except for this set, none of the others had preconceived right or wrong answers. The purpose was not to measure knowledge of the adult language, but to discover something about the child's strategies in relating objects.

Figure 2



The pictures are all line drawings depicting concrete nouns. The majority were taken from the Peabody Picture Vocabulary Test, since the style was fairly consistent and the objects definable. The remainder were either traced and modified or drawn conforming as much as possible to the style.

FEATURES

The most difficult part of designing the test was isolating and identifying the probable features involved. The problems were twofold: What was the nature of the attribute in which two objects differed or were the same; and what, for each object, was the "value" or specification of the feature. Should a round object be specified "round" for some feature shape, or "plus" for some feature round. Even the latter probably involves degree as well.

Since the test consisted of two-dimensional pictures of objects, it could only directly illustrate visual attributes; sound, texture, motion, function, etc. could only be inferred by relying on the child's knowledge of, and experience with the object depicted, as well as familiarity with conventions which translate these attributes into visual percepts. Smoke pointing towards the back of a train, for example, suggests it's moving. Some cues are more successful than others. Wherever an inferred feature has been used in a set, the most likely physical attribute providing the cue has been given as well, since of course not all children make the inference. By and large the objects were common enough that most of them were familiar to any child exposed to books and pictures.

Narrowing down the features would have been far simpler if the test had consisted solely of geometric shapes, allowing the experimenter complete control of the attributes' variation. However, I was more interested in exploring the fuzzier domains of the lexicon, containing concrete nouns of the sort a child deals within his earliest stage of

lexical acquisition. The first words learned unfortunately do not seem to be the most amenable to "componential" or feature analysis.

The features explored were: shape, size, color, texture/material, sound, function, situation (activity or state), detail shape (as opposed to overall shape; e.g., protrudences, handles or udders), pattern, age, sex, mass (vs. count), real, animate, human, and species.

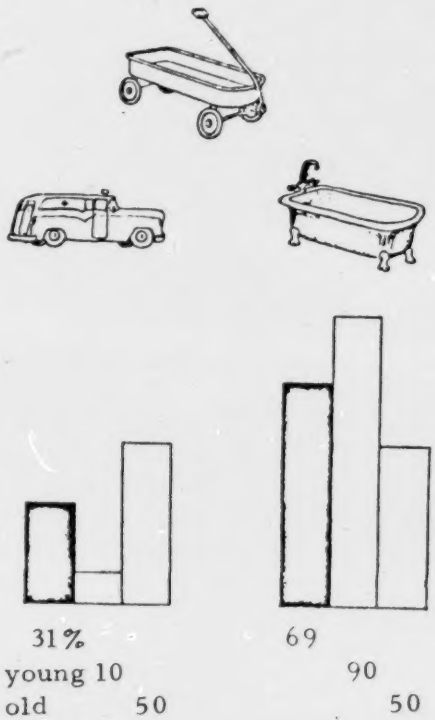
RESULTS

Each set was examined in several ways. First, the popularity of each choice (for the children as a whole) was compared with the other choices in the set to see if there were significant differences (an error range of plus or minus two standard deviations for each was used.) For instance, in figure 3 the choices below the stimulus reflect attention to the feature's "shape" on the right and "mobility" on the left (or "wheels," implying mobility). Here, shape prevailed. The left bar in each histogram represents percentage of all 45 children choosing that picture, 31% chose the ambulance, 69% the bathtub. Using the 2-standard deviation test one finds that neither figure lies in the other's error range and therefore could be considered a significant difference.

For each set the percentages by task group were computed, as well as by age group (divided into younger vs. older than the mean), and by sex. On this set there were no significant differences in the two tasks, but the younger children responded quite differently from the older, as illustrated by the middle and right bars in each histogram. Each shows the percentage of that age group who chose that picture (the first bar under each is the young group, the second the old.)

In terms of overall preferences no hierarchy of features emerged which was valid across all sets. In one set the children might overwhelmingly pick by shape as opposed to, say, color, but in another the popularity of the same two features might be reversed. What did seem

Figure 3



apparent was that it was not the feature that was important, but the specification (i.e., the value of that dimension).

The sets in figures 4 and 5 illustrate this. In figure 4 the features are fairly straightforward: the flag on the left differs from the stimulus in color only, and shares the features of size and pattern. The flag in the middle differs only in size, the one on the right in pattern. The overall favorite was the one on the right, significantly more popular than the other two, which were about tied. There were no notable differences in age or task groups. The results by task are shown but they don't differ significantly from the group as a whole. Here, though a quarter of the children ignored the color difference, most grouped by color. (This was true even for the linguistic task group, which is interesting in view of the findings in diary studies to the effect that color appears not to be used in overextensions.) Contrast this with the set in figure 5. Whereas in figure 4 the color differences were very striking, in figure 5 they were close enough to almost be viewed as shade variations. On this set the overall preference was for the flag in the middle, which shares all features with the stimulus except color. On this set, the task difference was significant on the left-hand flag -- no child doing the linguistic task chose that one, in other words, all used pattern as the criterion.

Figure 4

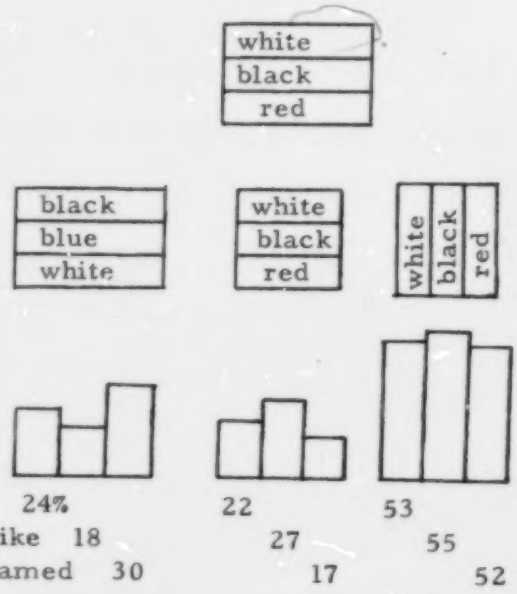
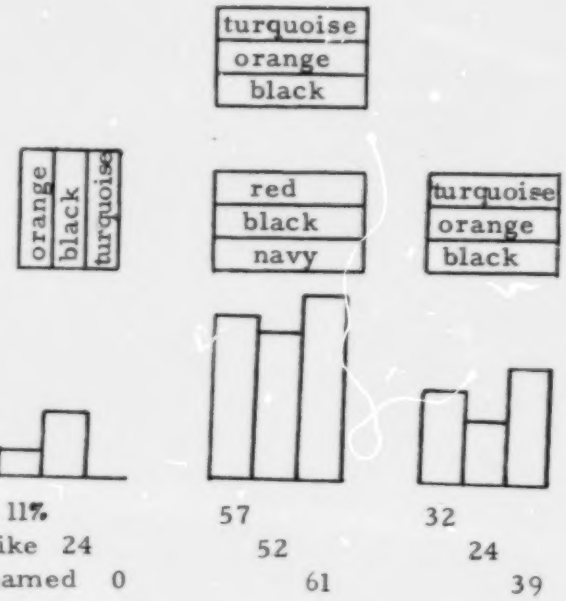


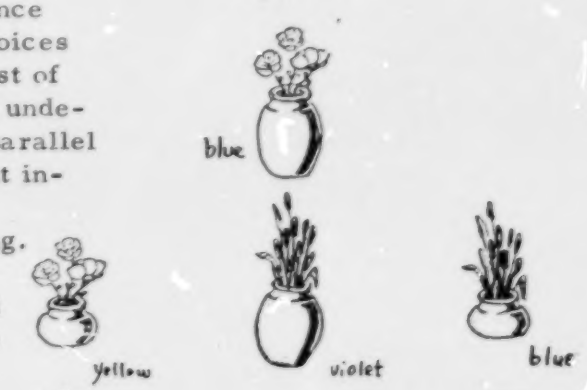
Figure 5

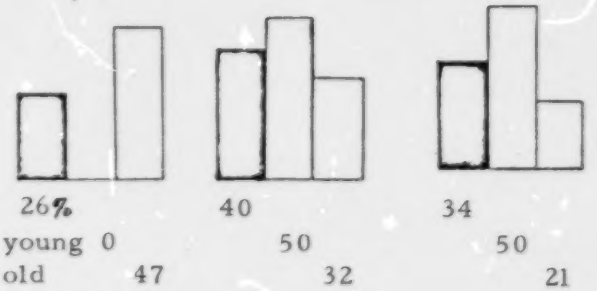


A second example involves the vases seen in figure 1. Here, of the three features the one involving "contents" turns out to be the most salient -- the presence or absence of the flowers overpowers the differences in height or color (73% grouped by contents). For an almost identical set, the flowers in both were replaced by a pencil, considerably less eye-catching, and the percentages shifted to 36%, 15%, and 49% from left to right, namely, away from the contents and doubling the popularity of color and size (left and right no longer differing significantly.) In yet a third set (see figure 6) the difference in contents was reduced even more, to where they all had flowers, but the nature of the flowers differed. The result was that all three vases were almost equally popular. The choice with similar contents actually had the lowest number, though not significantly so.

Figure 7 shows a third example. In this set, again the color difference is maximal. The left and right choices were almost equally popular -- most of the children grouping by shape but undecided between size and color. A parallel set was identical to this except that instead of the odd color being blue, it was red with dark cross-hatching. That particular choice, the same size and shape as the stimulus and now less different in color became by far the most popular (62% vs. 24% for the small-size one, and 13% for the ellipse).

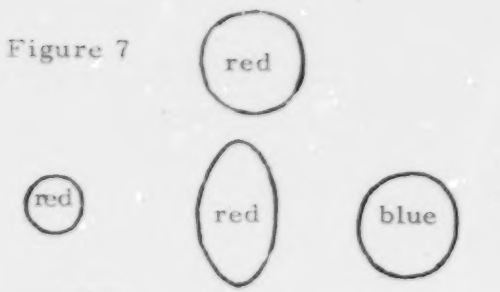
Figure 6

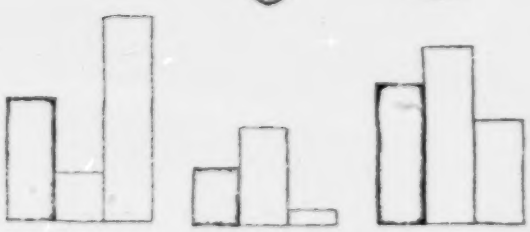




	26%	40	34
young	0	50	50
old	47	32	21

Figure 7

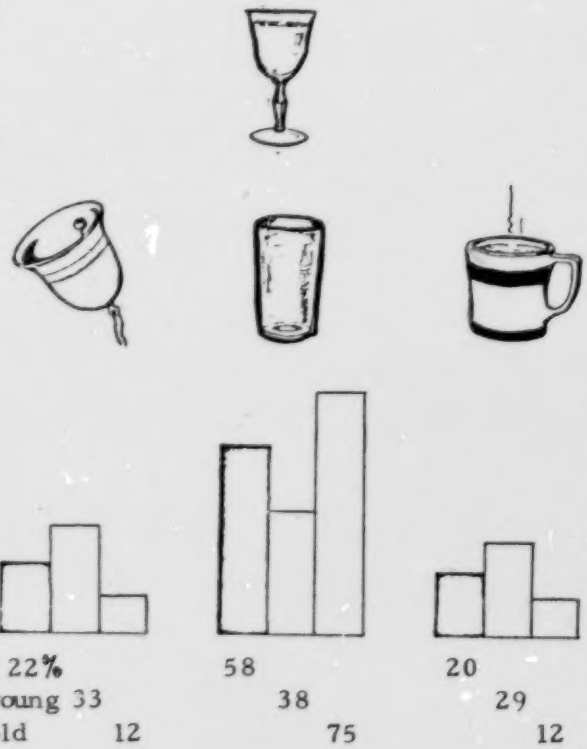




	38%	18	44
young	15	30	55
old	63	5	32

Figure 8 illustrates one last example. This set pits shape against function, and within function, material (cued by "transparency") against situation (containing liquid). Overall, more than half picked the water glass, ignoring both shape and situation. (Interestingly, 22% did actually choose the bell, showing shape is a salient feature for otherwise unrelated objects for children past the age of two. Most of the bell-choosers were in the younger group, though.)

Figure 8



Contrast this set with the one seen in figure 3, which also involved shape and something like function (perhaps mobility). Here the shape is somewhat more striking, and on this set recall the tub was the most popular. Again, it was the younger group which was most influenced by shape. The point I hope to make in these sets is that feature type alone, may not be sufficient in making predictions about a child's manipulation of words and concepts.

Some of the features tested turned out hardly to be features at all. Several sets involved similarities in configurations and patterns which were not easily analyzable into components. In some cases they were associated with actions, in some cases with states, but they had in common their being viewable as some sort of gestalt form. In figure 9 the choice on the right has very little to do with a wheel. It has some similarity of shape, but not as strongly as the other two choices. What it shares is something like pattern — one could say it has the same gestalt perception. The grapefruit tied for first choice with the tire, which shared function (perhaps rotatability) with the stimulus. The best candidate for shape in this set was the least popular. Note that the older group shifted significantly toward the tire.

Another example which involved pattern is the ball in the set in figure 10 which did not share much in the way of shape, and when contrasted with function on the left and shape on the right, faired poorly. Still, one should emphasize that some of the children did in fact choose the ball.

In one last example (see figure 11) the same gestalt form is an identity of action, on the right. Nearly three-fourths of the children chose the jumping boy, instead of grouping by age. Amazingly, there was a difference between age groups here -- the younger children were less attracted to the gestalt similarity than the older children.

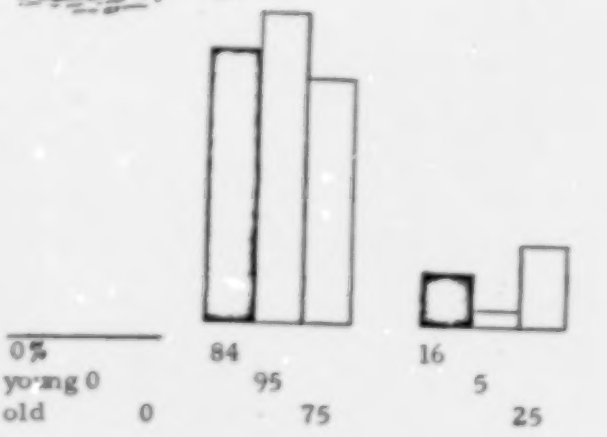
Figure 9

Figure 11

Figure 10

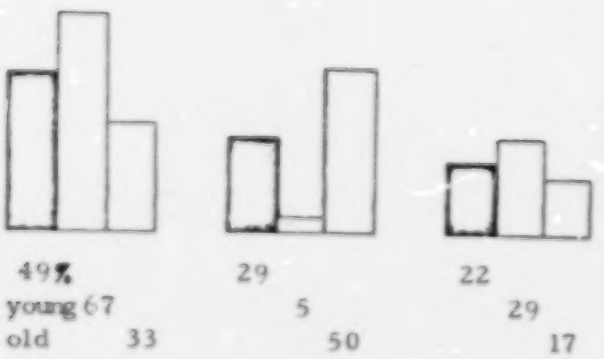
To demonstrate that action or state is not always so salient, the set shown in figure 12 enticed no one to pick the floating boat. Animacy provides more competition than age. Note in this set that the ones who picked the fish were largely from the older group. Since "water" isn't shown around it, the feature "aquatic" is inferrable only from some rather advanced knowledge of fish.

Figure 12



One of the questions purposely explored was whether the different task groups would treat color differently. The absence of color features in diary studies might be accidental, but if it is not, perhaps it is due to the linguistic nature of the language-learning task. In the set shown in figure 13, for example, the features were color, height, and detail-shape (namely "handle"). The overall favorite was in fact the bowl, being matched only by color. The other two were about equally unpopular. The histograms show there was age difference; the older children preferred the middle one on the basis of height. However, there was no significant task difference.

Figure 13

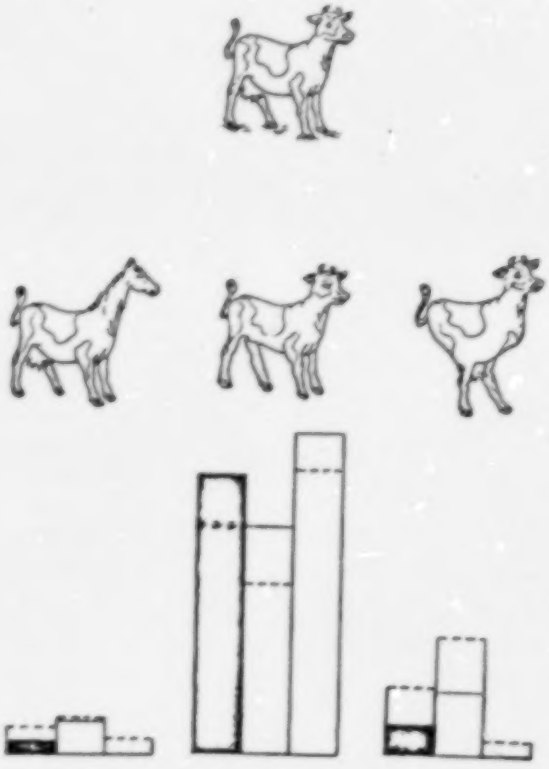


As it turned out, in the ten sets which involved color, two sets actually did produce significantly different results for the two task groups. These happened to be the same two which differed only minimally in color, namely the second set of flags and the second of circles. All other color groups were as maximal as possible (like red, yellow, blue) and none of those produced significant task differences.

One might conclude then that there is a tendency for the nature of the task to affect which features are attended to, but when the colors are strikingly different, this feature is the least ignorable and wipes out the task effect. When the color differences are tolerable, (red vs. orange) grouping objects by attaching names (namely, linguistically) tends to cross color boundaries more than grouping by similarity.

Two more sets were done with "unreal" objects to test some of the proposals for differentiation of animals (see figure 14). In the first such set, I was interested in whether the number of legs, the presence of udders, or the shape of the head was most important in the identification of a cow. As it turns out, some children do prefer udders to legs or head shape, but in most cases, udders turned out to be the most expendible feature of cows. Head-shape is probably not a single "feature," but whatever it is, it appears to be quite important in identifying animals. This was one of the sets which were repeated -- the results the second time, given in the lower numbers and dotted histograms, show a high degree of consistency, including the significant correlation with age. In both trials, the younger group was less unanimous than the older in favor of the udderless cow.

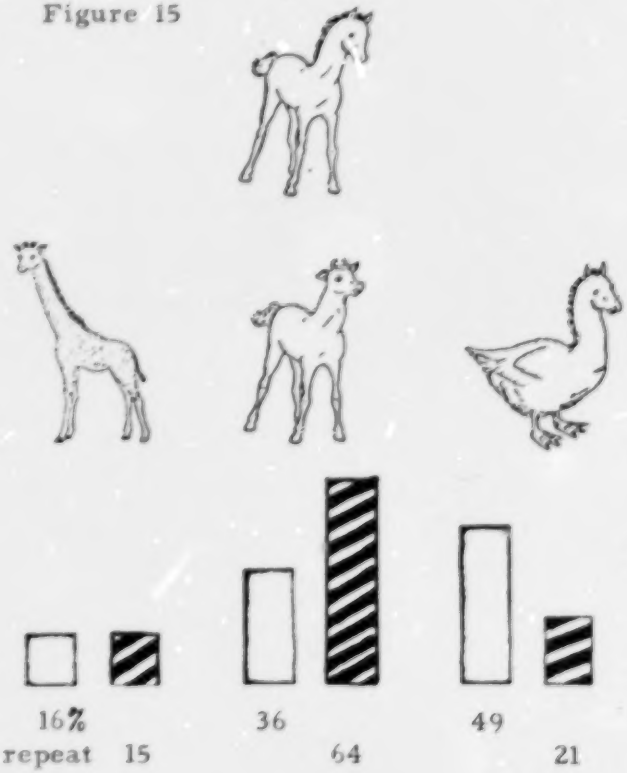
Figure 14



	4%	87	9
young	10	71	19
old	0	100	0
repeat	8	71	21
	11	53	37
	5	89	5

In the second such set (figure 15) the children were given the option of having a real animal to choose from. Here one animal shares the head only, with the stimulus, and one, the body. The giraffe shares neither exactly, but like the stimulus it is real. Many children commented on the absurdity of the other two, but went right ahead and picked them. The giraffe was the least popular in both trials of this set (independent of age). When he was chosen, it was largely by the linguistic task group. The head and body, however, were in tough competition in this set. Many children changed their strategies the second time around.

Figure 15

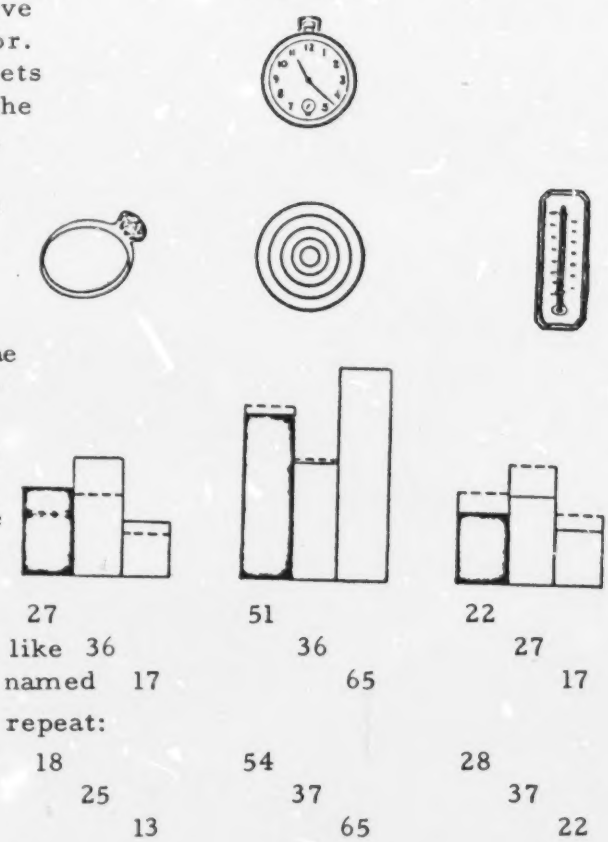


These sets also illustrate a tendency generally found in the repeated sets. In general, every such repeat had some changes of response, and most children changed their minds on at least one set. I feel this does not particularly invalidate their responses, rather it shows that for some sets where the features and specifications were highly competitive, many chose to reconsider. One five-year old explained when the test was over, why he had changed his mind on his only "inconsistent" set, which had as stimulus a smoking train, and as choices, a parked car and a smoking steamship. "You know the one with the train and boat?" he asked, "well, first I picked the car, but that was wrong 'cause it didn't have <u>smoke</u> coming out."

In fact there seems to be some correlation between sets with clear ranking and minimal response-changing, as opposed to sets with equally popular choices with a high degree of change in the second trial. The sets with the cow and colt suggested this. One more example of a repeat with a fairly low degree of change is shown in figure 16, with the set illustrating function (or numbers), versus overall shape, versus detail shape. Few children changed their minds in these sets, and the resulting totals were fairly close, including the task difference. (The linguistic task favored the overall shape.)

In sum, dividing the children by task produced somewhat suggestive results regarding the role of color. In addition, there were several sets which indicated that those doing the similarity task matched by detail shape somewhat more than the linguistic task group did, and the latter matched by overall shape a bit more than the similarity group did.

Figure 16



Dividing by age produces some differences in popularity of function, not surprisingly. The younger children stick somewhat more to purely perceptual features. The older ones also were a bit more attentive to the inferred feature, motion.

It has been proposed that the earliest "features" a child attends to are perceptual. By and large most overextensions reported have to do in fact with shape. The question of whether a preferential hierarchy exists among various perceptual categories is not definitively answered by this study, but the results suggest that one does not. Whether shape, size, color, or pattern, etc. will be the most salient may depend more on the context -- namely, what the respective values of the competing features are. This consideration seemed to be the overriding one throughout the 40 sets (how far apart in the spectrum two colors were, for example). The difference in number of legs is surely going to be more striking between two-legged animals and four, than six-legged ones and eight.

A theory of semantic features may have to be much more complex than we anticipated. If we knew what features were, we might be able to formalize their values and make some sort of corrections in weighting features. But in too many areas of the lexicon we do not yet know how to formalize them: features shade off into definitions, and specifications into features.

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